DEPOSIT RELIANCE, MARKET POWER AND MONETARY POLICY TRANSMISSION

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Abstract

This paper examines the role of banks' deposit reliance – the share of deposits over total liabilities – and deposit market power as potential drivers of the pass-through from monetary policy to bank funding costs and broader financing conditions. We first document that during the ECB's unprecedented monetary tightening cycle in 2022-23 the pass-through from policy rates to overnight deposit rates was extremely muted compared to historical regularities, highlighting a disconnect in monetary policy transmission. Using confidential bank-level data, state-dependent panel local projections and high-frequency monetary policy shocks, we then assess the role of deposit reliance and banks' market power in deposit markets in contributing to the weakening in the pass-through. While higher deposit reliance reduces the pass-through to overnight deposit rates, but only in the short term, the dampening effect of deposit market power is more persistent and extends to lending conditions for households and non-financial corporations.

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1. INTRODUCTION[1]

The transmission of monetary policy to banks' funding costs is crucial, as it directly influences financial intermediaries' pricing decisions, shapes the interest rates offered to borrowers, ultimately affecting credit availability and, in turn, economic activity. However, the unprecedented monetary tightening undertaken in 2022-23 by the European Central Bank (ECB) in response to the sudden awakening of inflation (Neri, 2024) was characterized by a very limited absolute increase of interest rates on overnight deposits (Lane, 2023), the main source of funding for euro-area banks.

In this paper, we evaluate the role of deposit market power and deposit reliance—defined as the share of deposits over total bank funding—as potential drivers of the pass-through (PT) from monetary policy to overnight deposit and lending rates in the euro area, with a specific focus on the last tightening cycle. We focus on these two factors because they both became more relevant during the phase of very accommodative monetary policy that anticipated the 2022-23 tightening cycle.

Between 2015 and 2021, banks experienced large inflows of deposits, given the low opportunity cost of holding money in a low interest rate environment and the large-scale asset purchase programmes implemented by the ECB. A higher reliance on deposit funding heightens the impact of a repricing of the entire stock of deposits on interest expenses and profitability, making banks less willing to pass on rate hikes to depositors (Gambacorta, 2008; Cappelletti et al., 2024).

After being remarkably stable over the period 2007-15, deposit market concentration trended upwards thereafter, similarly to deposit reliance, also owing

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to large-scale asset purchases and the introduction of the negative interest rate policy (Altunbas et al., 2023). Higher deposit market power can influence the transmission of monetary policy as banks, facing a more inelastic deposit demand curve, may limit the pass-through of policy rate increases and earn larger intermediation margins (the so-called *deposit channel of monetary policy* in Drechsler et al., 2017, and Drechsler et al., 2021).

In a nutshell, our main results are the following. The PT to the remuneration of overnight deposits during the 2022-23 ECB's tightening cycle was lower than implied by historical regularities. Moreover, the increase in banks' deposit reliance and in deposit market power both contribute to explain the muted relation between policy rates and the remuneration of overnight deposits. While banks' deposit reliance reduces the sensitivity to monetary policy mainly in the short term, the dampening effect of deposit market power is more persistent. The latter effect extends beyond banks' funding costs and affects the broader transmission of monetary policy to financing conditions for households (HHs) and non-financial corporations (NFCs). Finally, banks with higher deposit market power also show a more pronounced and persistent increase in their average loan-deposit spread, as the overall dampening effect on overnight deposits is greater than that on lending rates.

Framework. We assess the PT of changes in monetary policy rates to bank funding costs at both the macro- and micro-level. At the macro-level we rely on Bayesian VAR (BVAR) models, largely used for research and policy purposes (see, for example, Lane, 2023, and Panetta, 2024). Our small-scale BVAR includes three variables: short- and long-term market rates and the euro-area average interest rates for deposits from NFCs or HHs. After estimating the BVAR parameters over the sample spanning from January 2000 to December 2021, we compute counterfactual paths for deposit rates over the period January 2022-December 2023 and compare these patterns to those actually observed, in the spirit of the literature on conditional forecasting (see Jarocinski and Smets, 2008, and Aastveit et al., 2017, for the US economy; Giannone et al., 2019, and Auer and Conti, 2024, for the euro-area economy). The results inform us about the consistency between the observed PT and that implied by historical regularities, revealing whether there have been any changes in the monetary transmission mechanism to bank funding costs.

At the micro-level, we further assess the PT to overnight deposit rates by exploiting the combination of confidential individual bank-level data and state-dependent local projections techniques in a panel setting (see Jordà, 2005, Jordà and Taylor, 2024, and references therein). Specifically, we use two proprietary databases compiled by the Eurosystem: the individual Monetary and financial institutions Interest Rate (iMIR) database, which contains monthly data on deposits and lending rates, and the Individual Balance Sheet Indicators (iBSI) database that provides banks' main asset and liability items at an unconsolidated level. We start by assessing the PT from monetary policy to overnight deposit rates by using linear panel local projections and comparing the results with those obtained at the macro-level. We then deepen our analysis by adopting a state-dependent panel local projection framework to assess the extent to which banks' deposit reliance and deposit market power affect the transmission of monetary policy to the remuneration of overnight deposit rates from HHs and NFCs. These state dependencies are also assessed jointly to evaluate their relative importance in the short and medium term. The monetary policy shocks are based on high-frequency identification approach to compute interest rate surprises around the meetings of the ECB Governing Council (Altavilla et al., 2019; Jarociński and Karadi, 2020).

Results. We document three main findings. First, during the ECB's unprecedented monetary tightening cycle in 2022-23 the pass-through from policy rates to overnight deposit rates was extremely muted compared to historical regularities, highlighting a weakening of the transmission of monetary policy to bank funding costs. The counterfactual path obtained with the BVAR model is indeed unable to replicate the limited increase in overnight deposit rates since January 2022. Given the observed rise in short- and long-term market rates, the remuneration of overnight deposits would have been higher by about 70 bps for HHs and 100 bps for NFCs at the end of 2023. The PT to deposits with an agreed maturity was instead in line with historical regularities.

Second, we show that both bank deposit reliance and deposit market power contribute to dampening the PT from reference rates to overnight deposit rates. Specifically, against a 100 bps increase in the reference rate, a bank with a share of deposits over total funding at the 75th percentile, compared to a bank at the 25th percentile, on impact would pass on 10 bps less to the remuneration of overnight deposits from NFCs and 15 bps from HHs. For deposit market power, the dampening of the PT on impact is by 5 and 3 bps, respectively. After 12 months, the attenuation in the PT associated with deposit reliance vanishes almost completely, while deposit market power still reduces the PT to overnight rates significantly by around 10 (6) bps for overnight deposits from NFCs (HHs). Although these figures may seem small in magnitude, they account for a significant fraction of the cross-sectional variation in the PT across intermediaries. When assessing the relative importance of these two factors jointly, we indeed find confirmation that increased deposit reliance dampens the PT to overnight deposits only in the short term, while deposit market power has a more persistent effect.

Finally, we find that only deposit market power has a dampening effect also on the pass-through from monetary policy to lending rates, suggesting that its influence extends beyond bank funding costs and affects the broader transmission of monetary policy to financing conditions for households and non-financial corporations. After 12 months, the attenuation in the PT associated with higher deposit market power is around 10 bps for NFCs lending rates and 6 bps for mortgage rates[2]. However, the net effect on the loan–deposit spread is positive, as the decrease in the pass-through to deposit rates more than offsets the corresponding decrease for lending rates due to composition effects in the loan and deposit mix between households and non-financial corporations.

Our findings provide relevant policy implications. The increase in the share of deposits driven by the prolonged period of very accommodative monetary policy likely had only a transitory dampening effect on the transmission of the subsequent tightening impulse to bank funding costs and lending rates. However, the rise in deposit market power, possibly associated with some banks being able to exploit their privileged position in a context of rising deposit funding, could have hampered significantly the transmission of monetary policy. Therefore, progress in policy actions aimed at fostering greater euro-area banking integration should also address the role of banks' market power in order to continue ensuring a smooth transmission of monetary policy.

Connection to the literature. Our paper belongs to the large empirical literature on the transmission of monetary policy in the euro area. This vast literature can be sorted according to the nature of the approach adopted: looking at aggregate data and using macro-econometric methodologies (Peersman and Smets, 2001; Boivin et al., 2009; Giannone et al., 2012; Barigozzi et al., 2014; Ciccarelli et al., 2015); or instead relying on disaggregated data and being inherently based on more micro-econometric oriented techniques (Boeckx et al., 2020; Altavilla et al., 2022). In this regard, we combine both macro- and micro-econometric methodologies to assess the first leg of the monetary transmission mechanism – i.e., the pass-through from policy rates to bank interest rates – focusing specifically on the 2022-23 ECB's

[2] Since our analysis focuses solely on interest rates and not credit quantities, we interpret our findings as a lower bound on the total effect on bank lending, which may as well arise from a contraction in lending volumes.

unprecedented monetary tightening and on deposit rates, for which the evidence is relatively scarcer.[3]

We contribute in particular to the large literature that emphasizes the role of banks in the monetary transmission mechanism in the euro area (Peersman, 2012; Hristov et al., 2014; Giannone et al., 2019; Altavilla et al., 2020). Specifically, we add to recent papers that explore factors possibly contributing to the muted pass-through from monetary policy to deposit rates in the 2022-23 ECB's tightening cycle. Kho (2024) use country- and bank–level data to document that deposit rates respond symmetrically to monetary tightening and easing and that more concentrated domestic banking sectors do pass-on monetary policy shocks more slowly than less concentrated ones. Messer et al. (2023) show that, even after controlling for bank competition, the levels of excess reserves explain cross-country variation in the response of deposit rates, suggesting that the low pass-through was likely associated with the abundance of liquidity introduced by monetary policy interventions during the pandemic period. Fricke et al. (2023) explore the effect of large excess reserves on monetary policy transmission using bank-level data, finding instead only a limited impact of reserve ratio in explaining the low pass-through of deposit rates to changes in the DFR. Beyer et al. (2024), using country-level data, find that the weakening of the pass-through to deposit rates at country level is partly related to higher financial sector concentration, ampler deposits, and liquidity.[4]

In this respect, our contribution is the joint assessment of the role of deposit market power and deposit reliance – a mirror image on the liability side of the

[3] Several papers focused on the transmission of negative interest rates to deposits rates. Heider et al. (2019) document that banks were reluctant to pass on negative rates to depositors, which increased the funding cost of high-deposit banks relative to low-deposit banks. Altavilla et al. (2022) show that for sound banks the pass-through to firm deposits was not impaired when policy rates moved into negative territory.

[4] Fabiani and Piersanti (2023) study the dynamic response of deposit rates and volumes to changes in monetary policy rates in Italy and show that the pass-through to overnight deposit rates has decreased over time, exploring the role of deposit market concentration.

reserve abundance on the asset side – in explaining the broken link between policy rates and overnight deposit rates during the 2022-23 ECB's tightening cycle. To the best of our knowledge, we are the first to provide such a comprehensive analysis, relying on bank-level data and state-dependent panel local projections.

Outline of the paper. The paper is organised as follows. The next section documents a set of stylised facts regarding the limited pass-through of policy rate hikes to deposit rates during the ECB's monetary policy tightening in 2022-23 and the evolution of banks' deposit reliance and market power. Section 3 describes the data and the empirical framework. Section 4 presents the empirical results on euro-area deposit rates and the implications for the transmission to lending rates. Finally, Section 5 concludes.

2. STYLIZED FACTS

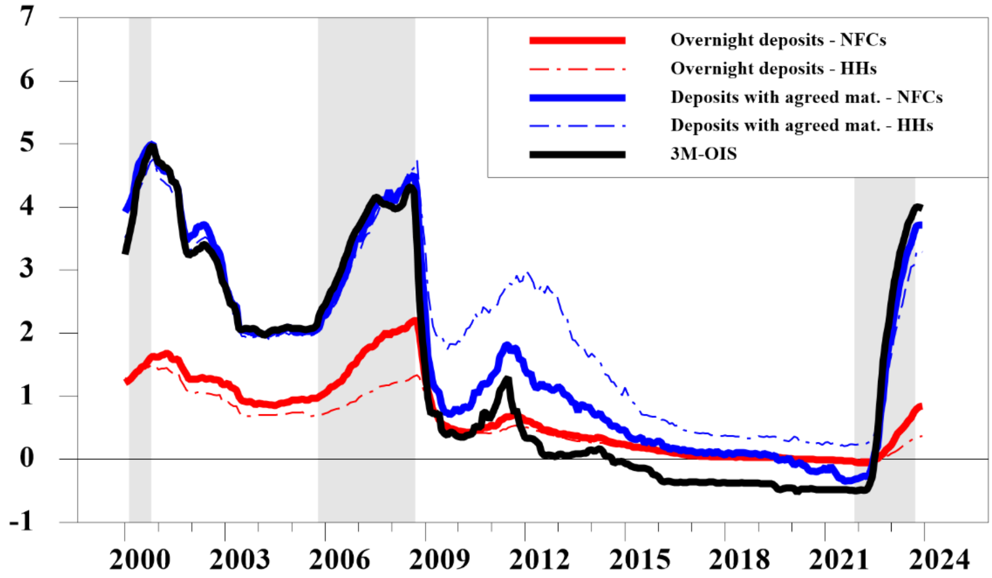
In this Section we first evaluate the PT from policy rates to deposit rates in a BVAR framework. We then describe the evolution of banks' deposit reliance and deposit market power in our sample.

2.1 The missing pass-through to overnight deposit rates

Between July 2022 and September 2023, the ECB has embarked on a rapid tightening cycle amid persistent inflationary pressures. The deposit facility rate was raised from its historically low and negative level of -0.5% to 4.0%, with an overall increase by 450 basis points. Over the same period, the average remuneration of overnight deposits from non-financial corporations and households in the euro area remained close to zero with only very limited increases (Figure 1).[5]

[5] The average interest rate on overnight deposits from non-financial corporations raised from -0.1 to 0.8%, that on overnight deposits from households from 0.0 to 0.3%, with an overall increase by 90 and 30 basis points, respectively.

FIGURE 1. OVERNIGHT DEPOSIT AND RISK-FREE RATES



Notes: This figure plots the evolution of the remuneration of overnight deposits and deposits with an agreed maturity from households and non-financial corporations in the euro area, together with the 3month-OIS rate. Light grey shaded areas denote ECB tightening cycles.

After a prolonged period of negative spreads in a low interest rate environment, the differences between the three-month risk-free rate and the average interest rates on overnight deposits turned again positive and rapidly approached their historical maximums in late 2023.[6] The evolution of the remuneration of deposits with agreed maturities was less anomalous over the same period, with increases that were more in line with that of the risk-free market rate and spreads that remained at much narrower levels.

Although there is ample evidence in the literature of a limited pass-through of policy rate hikes to the remuneration of overnight deposits, an eyeball exam of the 2022-23 ECB's tightening cycle suggests that it has been much lower compared to past cycles. To properly assess this muted pass-through, we conduct a simple

[6] The spread between the reference market rate and overnight deposit rates was at 320 and 370 basis points, respectively, for non-financial corporation and households. The previous peaks were observed at the end of 2000, when the process of interest rate convergence was still underway (with spreads at 335 and 345, respectively), and in the second half of 2008, towards the end of the tightening cycle undertaken before the outbreak of the Global financial crisis (respectively at 230 and 310 basis points).

counterfactual analysis within a Bayesian VAR (BVAR) framework, in the spirit of Aastveit et al. (2017), Giannone et al. (2019) and similar analyses on lending volumes and rates in the euro area (Auer and Conti, 2024; Conti et al., 2024).[7] The BVAR includes short- and long-term market rates, directly affected by monetary policy, and interest rates on deposits (from NFCs or HHs, one at a time).

In more detail, we design a series of exercises aimed to project the dynamics of deposit rates for NFCs and HHs in the EA since 2022:M1 using conditional forecasts. They can be interpreted as counterfactual scenarios that enable to assess whether the evolution of deposit rates during the 2022-23 ECB's tightening cycle could have been anticipated based on historical regularities. In practice, each exercise consists of three steps. First, we estimate the BVAR coefficients over the sample 2000:M1-2021:M12,[8] just prior to the increase in market interest rates driven by the start of the normalisation process of monetary policy and the consolidation of expectations of imminent policy rate hikes.[9] Second, we assume that the evolution of short- and long-term market rates are known for the full sample until 2023:M12. Third, we compute conditional forecasts for deposits rates over the period 2022:M1-2023:M12, based on the estimated coefficients (step 1) and the conditioning set (step 2).

The results confirm the eyeball exam, as the PT of monetary policy to deposit rates was sensibly lower relative to previous tightening cycles. The predicted counterfactual path of overnight deposit rates for NFCs and HHs rises up to about 1.6 and 1%, respectively, with implicit pass-through of about 0.4 and 0.25 that are consistent with historical regularities and previous estimates (see Figure 2a-2b,

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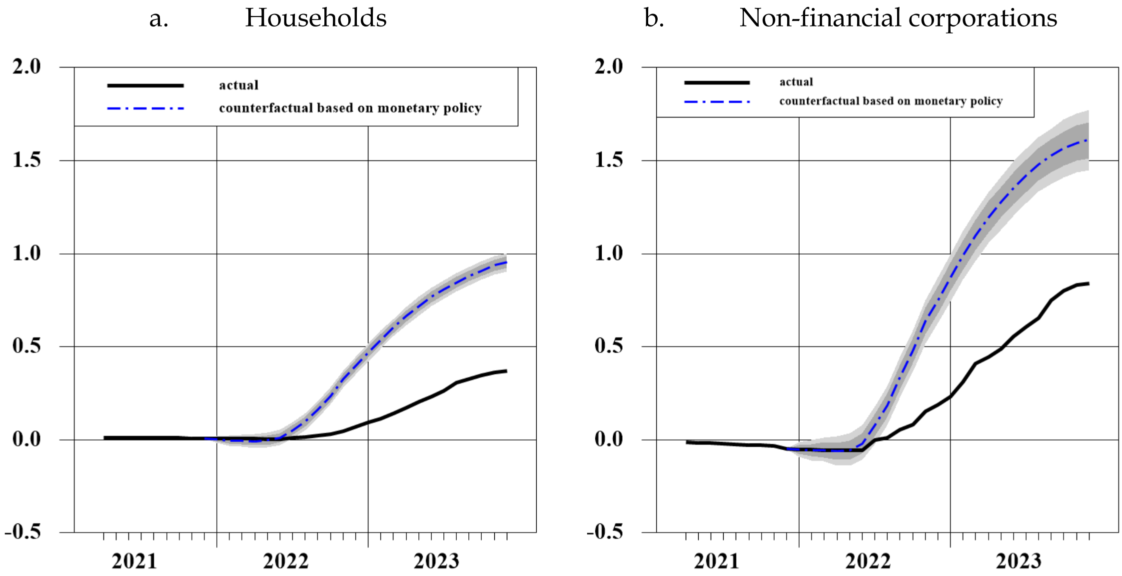
[7] For further details, see Appendix A.

[8] To check for the impact of the pandemic period, we also estimate the model until 2019:M12 and then compute counterfactuals since 2022:M1. The results are broadly in line with those presented here.

[9] In December 2021, the ECB announced its decision to discontinue the net asset purchases under the Pandemic Emergency Purchases Programme (PEPP) at the end of March 2022. The most recent literature on large-scale asset purchases shows that the PEPP was very effective in stabilizing financial markets and lowering sovereign bond yields (see, e.g., Bernardini and Conti, 2023).

respectively; De Bondt, 2005). It is immediate to see that the actual evolution of the remunerations of overnight deposits was significantly weaker than that obtained in their counterfactual patterns.

FIGURE 2. MISSING PASS-THROUGH FROM POLICY TO OVERNIGHT DEPOSIT RATES



Notes: The dark (light) grey shaded area is the 68% (90%) credible interval obtained from the BVAR posterior distribution. Estimation sample is 2000:M1-2021:M12. Counterfactual sample is 2022:01-2023:M12.

Notice that this missing PT to overnight deposit rates is a unique feature of the 2022-23 ECB's tightening cycle. In fact, the model does generally a good job in anticipating the evolution of these remunerations when conditioning on the path of market rates.[10] Moreover, the PT to interest rate on deposits with an agreed maturity (or term deposits) for both NFCs and HHs is perfectly in line with historical regularities (Figure A2 in the Appendix).[11]

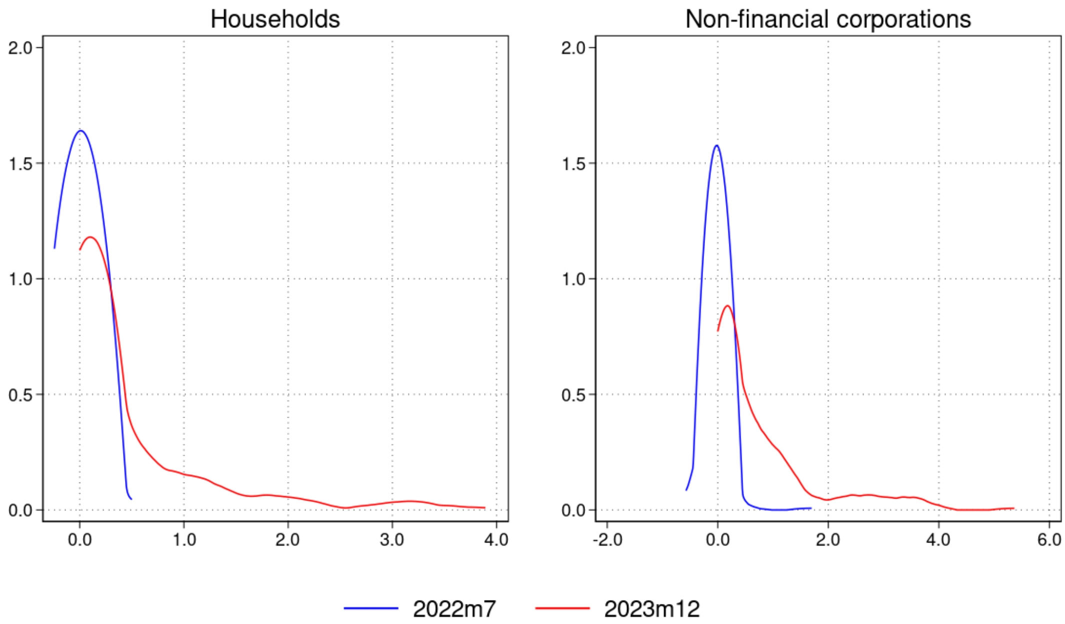
When turning from aggregate to bank-level data, the behaviour of credit intermediaries was however rather heterogeneous, with some banks passing on the

[10] In the Appendix we conduct a similar counterfactual analysis for the 2005-08 ECB's tightening cycle. Specifically, overnight deposit rates for HHs are perfectly predicted (Figure A2a), while the model yields a slight underestimation of overnight deposit rates for NFCs (Figure A2b).

[11] We basically conduct the same counterfactual analysis by just replacing overnight deposit rates with term deposit rates. The resulting counterfactuals are almost perfectly overlapping to the actual rates.

increases in key policy rates to the remuneration of overnight deposits to a greater extent. Kernel density estimates at the beginning and at the end of the ECB's tightening cycle in 2022-2023 show that there was a clear shift in the distribution of overnight deposit rates into positive territory and an increase in the dispersion, which was drastically compressed in the low interest rate environment (Figure 3). The positive skewness indicates that some customers received significantly higher remuneration on their overnight deposits than the mean by December 2023.

FIGURE 3. KERNEL DENSITIES OF OVERNIGHT DEPOSIT RATES



Notes: the probability density function is approximated using the Epanechnikov kernel and a bandwith of 0.2.

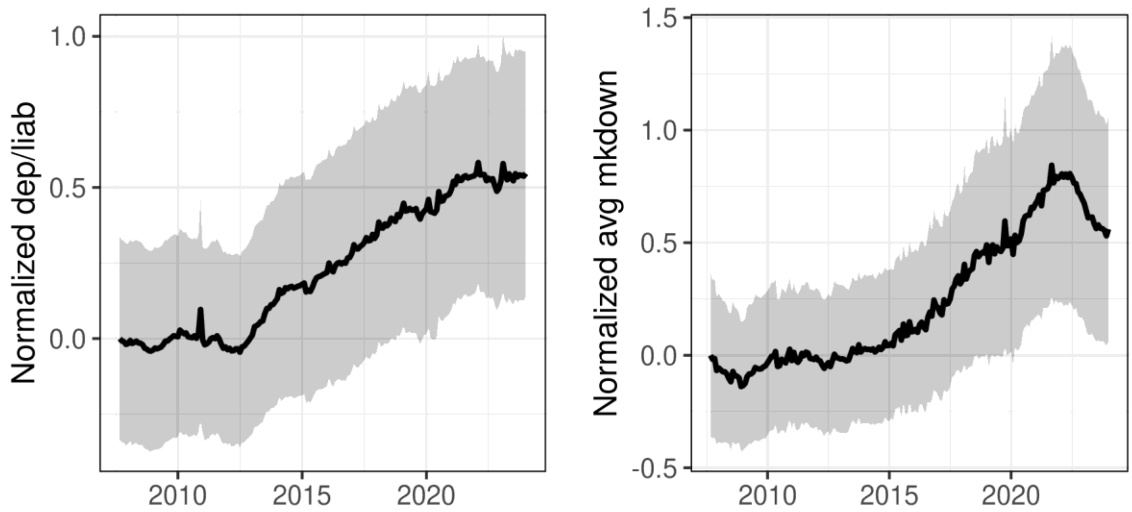
2.2 *The evolution of banks' deposit reliance and market power in the euro area*

In our empirical investigation, we try to correlate the heterogeneity in the pass-through to overnight deposit rates to two specific bank-level characteristics: the reliance of banks on deposit funding and the market power in the deposit market. While previous literature highlights several other potential drivers of the pass-through to both deposit and lending rates, we concentrate on these two characteristics due to their evolution before the start of the tightening cycle.

We measure deposit reliance as the share of deposits over total liabilities at bank-level. Since deposit market power is not directly observable in the data, we estimate it through a model of imperfect bank competition in the spirit of Albertazzi et al. (2022). We provide more details in the next section and in the Appendix. In Figure 4 we plot the standardized time series of our measures of deposit reliance (panel a) and deposit market power (panel b). We note a clear upward trend in both variables especially after 2015. The cross-sectional dispersion (shaded area) also increased, especially for banks' deposit market power.

FIGURE 4. EVOLUTION OF SELECTED BANKS' CHARACTERISTICS

a. Deposit reliance b. Deposit market power



Notes: This figure plots the evolution of our bank-level measure of deposit reliance (panel a) and deposit market power (panel b). We standardize each variable by subtracting the mean and dividing by their standard deviation; we also normalize both series to start at 0 at the beginning of our sample. The black solid line denotes the median and the upper and lower bound of the shaded area are the 40% and 60% percentile, respectively. Our sample runs from 2008M07 to 2023M12 at monthly frequency.

This surge in both deposit reliance and deposit market power is likely to have been directly influenced by the very accommodative monetary policy stance undertaken until the beginning of 2022.

In a low interest rate environment, with reduced opportunity costs of holding money, banks experienced large inflows of overnight deposits from customers that were less attracted by the remunerations of other, potentially riskier, saving options. Moreover, the asset purchases conducted under the APP and the PEPP effectively injected ample liquidity in the banking system. When bonds purchased by the Eurosystem were held by the private sector, the corresponding proceeds were mechanically credited to their bank accounts, thereby increasing (overnight) deposits. Hence, when policy rates were increased in the subsequent tightening cycle, banks could have been less willing to pass on rate hikes to depositors because of the large interest expenses they would incur from the repricing of the entire stock of deposits.

The increase in deposit market power went roughly hand in hand with the increase in deposit reliance, at least until the beginning of the tightening cycle, as some banks were possibly able to exploit their privileged position during this phase of large deposit inflows. There is indeed some evidence that the introduction of negative interest rates was associated with an increase in banks' market power (Altunbas et al., 2023).[12] During a monetary tightening, banks with a higher degree of market power can charge customers a higher markdown, meaning a larger (typically positive) spread between the market reference rate and the deposit rate.

It is important to highlight that these two bank characteristics can vary independently across different banks. Large banks with high deposit market power do not necessarily have high deposit reliance, as they may easily access the wholesale market to better diversify their funding structure. For the opposite reason, small banks with low deposit market power may have a high share of deposits in their total liabilities. In our data we find only a mild correlation between deposit reliance and market power in the cross-section (with a positive coefficient of 0.23), supporting the idea of analyzing separately the impact of these bank characteristics on monetary policy transmission to deposit rates.

[12] The increase in market power was also likely influenced by the waves of mergers and acquisitions following the Great Financial Crisis (ECB, 2024). The number of credit intermediaries in the euro area decreased by around a third between 2010 and 2023 (ECB, 2024).

3. EMPIRICAL FRAMEWORK

In this Section, we first describe the data used in the analysis and then illustrate the empirical methodology.

3.1 Data

We source the bank-level deposits and lending rates from the individual Monetary and Financial Institution Interest Rates (iMIR) database, which provides interest rates charged by individual banks resident in the euro area. To construct our measures of deposit reliance and market power, we also use data on banks' main asset and liability items at the unconsolidated level from the Individual Balance Sheet Indicators (iBSI) database. After the merge with iMIR data, we have information on 332 banks residents in the euro area from July 2007 to December 2023.[13] The sample is overall representative of the banking system, as it covers about 70% of bank total assets in the euro area.[14]

We measure banks' deposit reliance as the share of deposits on total liabilities at bank-level. We prefer to use this indicator on the liability side rather than the reserve ratio on the asset side as in Messer et al. (2023) and Fricke et al. (2023) for two main reasons. First, iBSI data on bank deposits held with the Eurosystem are not available for a large number of credit intermediaries, thereby limiting the cross-sectional information available to effectively exploit the relationship under investigation. Second, the surge in reserve ratios and its heterogeneity across banks emerged especially after the implementation of non-standard monetary policy tools, in particular after 2014, therefore also limiting the time dimension to exploit.

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[13] About half of reporting banks are located in the four main euro-area countries (60 in Germany, 34 in Spain, 40 in France and 37 in Italy).

[14] The degree of representativeness of reporting banks is more dispersed across countries, but the share of their assets is below 60% of the banking system only in four countries (Austria, Ireland, Luxembourg and Malta).

For banks having information about their deposits held with the Eurosystem, we checked that reserve ratio is highly correlated with deposit reliance after 2014.

We compute deposit market power by means of deposit markdown, i.e., the (typically positive) spread between the policy rate and banks' cost of deposits. The latter includes both the marginal costs of deposits and the actual deposit rate that banks pay to their customers.[15] We estimate the deposit markdown through a logit model of deposit demand as in Albertazzi et al. (2022). Importantly, we account for differing demand elasticities between firms and households, by estimating two separate demand systems. Additionally, we consider partial substitutability between overnight and time deposits, with the latter adjusting much more closely to the policy rate than overnight deposits, particularly during the 2022-23 tightening cycle.[16] Our procedure allows us to back-out a measure of deposit market power that varies both in the time series and in the cross-section of banks and that is positively related to individual market share in the deposit market. In the Appendix we provide full details of the methodology. Compared to the Herfindahl–Hirschman Index (HHI), generally used in the macroeconomic literature, our measure should better capture the ability of banks to price deposits below their marginal costs – a definition of market power – in relation with the shape of the demand curve. Nevertheless, the correlation between our indicator and the HHI is quite high and ranges between 60% and 70%.

We borrow from Jarociński and Karadi (2020) the series of monetary policy shocks in the euro area that is constructed by using a high-frequency identification approach in the spirit of Gürkaynak et al. (2005) and Gertler and Karadi (2015). The policy announcement surprises, obtained by observing movements in market rates within an intraday window around monetary policy meetings, are adjusted to

[15] Note that only in the case of zero marginal costs we could measure the deposit markdown directly in the data.
[16] This is one of the main differences with respect to the methodology in Albertazzi et al. (2022), as they instead focus on the distinction between insured and uninsured total deposits.

account for information shocks, i.e., movements that reflect information that the central bank possesses about future economic conditions, rather than a direct monetary policy change (Nakamura and Steinsson, 2018). To this extent, the series of pure monetary policy shocks is obtained using the so-called “poor-man’s” sign-restriction procedure that keeps the surprises only when there is a negative co-movement with the equity price index within the intraday window.

3.2 *Panel IV local projections*

Our aim is to assess how bank interest rates respond to changes in their relevant market reference rate that are induced by exogenous monetary policy shocks. To this extent, we use a panel IV local projection framework along the lines of Jordà and Taylor (2024). This allows quantifying the impact of the monetary policy shocks through the cumulative “multiplier” rather than with impulse responses. In our framework, this monetary multiplier could be interpreted as the ratio between the cumulative response of bank interest rate (y^j) over a predefined horizon (h) and the cumulative response of a market reference rate (i) over the same horizon, conditional on a monetary policy surprise (ε).[17] This simple metric effectively represent the pass-through of monetary policy shocks to bank interest rate.

In line with Ramey and Zubairy (2018), we estimate the cumulative monetary multiplier in a one-step procedure using the following benchmark specification:

$$y_{t+h}^j - y_{t-1}^j = \delta_0^h + \delta_1^h (i_{t+h} - i_{t-1}) + \Gamma X_{t-1}^j + \lambda^j + v_{t+h}^j \tag{1}$$

[17] Alessandri et al. (2023) used a similar metric to gauge how successful the Fed is in influencing the economy by shifting the actual funding costs of US firms and households.

which is estimated using the exogenous monetary policy shock ε_t as an instrument for $i_{t+h} - i_{t-1}$.[18] In equation (1), j denotes banks and t time at monthly frequency. The dependent variable is the long difference of the bank-level interest rate $\Delta_h y_{t+h}^j = y_{t+h}^j - y_{t-1}^j$, with y_t^j being the overnight deposit rate for households and non-financial corporations (as in section 4) or the lending rate for new loans (as in section 5).[19] The main regressor $\Delta_h i_{t+h} = i_{t+h} - i_{t-1}$ is the long difference of the relevant market reference rate. We use the 3-month Euribor for overnight deposits, the 1-year IRS for loans to non-financial corporations and the 10-year IRS for mortgages, given their longer average contractual duration. X_{t-1}^j is a vector of (lagged) controls, which in our baseline includes 6 lags of first difference of the bank-level interest rate, Δy^j, 6 lags of the first difference of the market reference rate, Δi, as well as country-level monthly change in consumer price and industrial production indexes, both sourced from Eurostat. Finally, λ^j denotes bank fixed effects. In this benchmark specification, our main interest is in estimating the "unconditional" cumulative multiplier of monetary policy shocks at each horizon h, ϕ_h^{uncond}, which is given by the parameter δ_1^h.

We then extend our benchmark specification allowing for a state-dependent pass-through of monetary policy shocks to bank interest rates. In particular, we include an extra term $S_{t-1}^j(i_{t+h} - i_{t-1})$ where we interact the change in the market reference rate with a predetermined bank-level characteristics leading to the following specification:[20]

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[18] The one-step procedure returns the same estimate of a more complex three-steps procedure in which the multiplier is computed as the ratio between the cumulative impulse responses of bank interest rate and market reference rate to monetary policy shocks at each horizon. The one-step procedure has various advantages, among which the direct estimate of the standard error of the multiplier (see Ramey and Zubiary, 2018).

[19] As in Jordà and Taylor (2024), we use a specification in long difference rather than in levels to account for the short-sample bias in local projections. For the sake of simplicity, we will hereafter report the first difference of a variable of interest as $\Delta y_t^j = \Delta_1 y_t^j = y_t^j - y_{t-1}^j$.

[20] We specify a predetermined bank-level state variable $S_{t-1}^j$to avoid the possible contemporaneous influence of the shock on the state variable itself.

$$y_{t+h}^{j} - y_{t-1}^{j} = \delta_0^h + \delta_1^h(i_{t+h} - i_{t-1}) + \beta^h S_{t-1}^{j}(i_{t+h} - i_{t-1}) + \Gamma X_{t-1}^{j} + \lambda^j + v_{t+h}^{j} \quad (2)$$

where S_{t-1}^{j} is either the indicator of bank deposit reliance or deposit market power as defined in the previous section. Similarly to equation (1), the state-dependent (or conditional) pass-through at each horizon h, Φ_h^{cond} is given by $\delta_1^h + \beta^h S_{t-1}^{j}$ and consists of an average constant term δ_1^h plus a (possibly) bank-level and time-varying term $\beta^h S_{t-1}^{j}$.

4. RESULTS

4.1 Linear evidence

In this section we present the key findings regarding the unconditional pass-through of monetary policy to overnight deposit rates from households (HH) and non-financial corporations (NFC) using the methodology outlined in equation (1). Our analysis focuses on the recent ECB's monetary tightening cycle in 2022-23 by comparing the cumulative monetary multiplier estimated over the whole sample up to December 2023 to that obtained ending the sample in June 2022, i.e., just before the first increase in the DFR.[21]

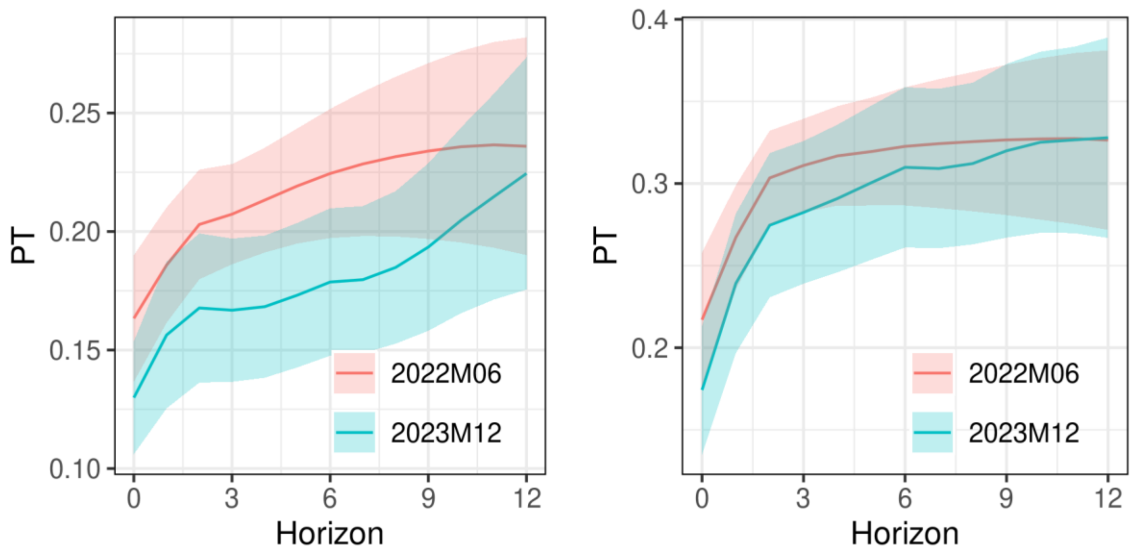
The unconditional pass-through from monetary policy to the remuneration of overnight deposits from households (Figure 5, panel a) estimated including the 2022-23 ECB's tightening cycle is *i)* lower than that obtained by ending the sample in June 2022, and *ii)* small in magnitude, so that on average a 100 basis points (bps) increase in the reference rate would imply only a 20-25 basis points increase in the overnight deposit rate from households after 12 months. The pass-through to the remuneration of overnight deposit from non-financial corporations (Figure 5, panel

[21] This data split allows us to have enough statistical power to focus on the 2022-23 monetary tightening cycle.

b) is larger in magnitude, close to 0.35, reflecting the idea that banks are more reactive to change deposit rates from firms rather than those from households. Comparing the pass-through in the pre-tightening sample and in the extended one, there is still a difference in the magnitude, but less significant.

FIGURE 5. UNCONDITIONAL PASS-THROUGH TO OVERNIGHT DEPOSIT RATES

a. Households b. Non-financial corporations



Notes: This figure plots the impulse response of a monetary policy shock for ON deposit rates from households (panel a) and non-financial firms (panel b) from the estimation of equation (1) on two samples: from 2008M07 to 2022M06 (pre-tightening, denoted as 2022M06) and from 2008M07 to 2023M12 (full sample, denoted as 2023M12). The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

It is important to stress that the pass-through from monetary policy to overnight deposit rates estimated using the linear panel IV local projection and the sample ending in June 2022 is very similar in terms of magnitude to that implicit in the BVAR analysis with aggregated euro-area data presented in Section 2. Moreover, we also remark that our results are robust to using different monetary policy shocks (Altavilla et al., 2019) and to direct OLS regression.[22]

4.2 State-dependent evidence

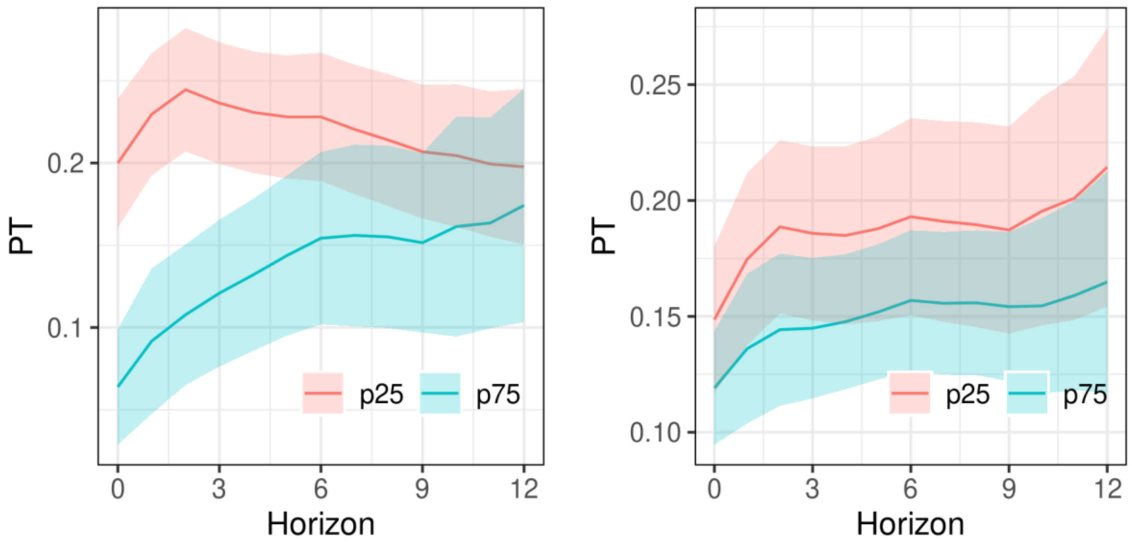
[22] See figures C1-C2 in the Appendix.

In this section, we explore whether the more subdued pass-through in the 2022-23 tightening cycle could be associated with: *i)* a change in the composition of banks' funding, with a higher reliance on deposit, and *ii)* an increase in banks' market power in the deposit market.

To assess both drivers separately, we estimate equation (2). This specification effectively implies a state-dependent pass-through that consists of a constant average effect and a conditional effect that instead depends on the bank-level value of the state variable, either deposit reliance or deposit market power.

FIGURE 6. STATE-DEPENDENT PASS-THROUGH TO OVERNIGHT DEPOSIT RATES FROM HOUSEHOLDS

a. Conditioning on deposit reliance   b. Conditioning on deposit market power



Notes: This figure plots our estimates of equation (2) for the impulse response of a monetary policy shock for ON deposit rates from households conditioning on deposit reliance (panel a) and deposit market power (panel b). The two lines p25) and p75) denote, respectively, the first and third quartile of the distribution of our conditioning variable. Our sample spans from 2008M07 to 2023M12 at monthly frequency. The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

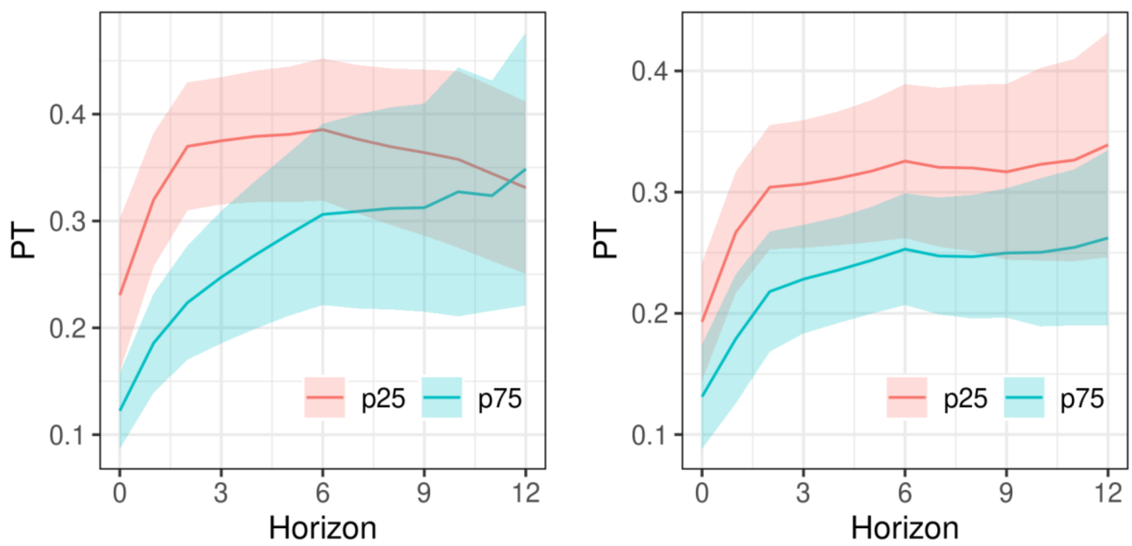
Figure 6 and 7 report our results[23] for the state-dependent pass-through to interest rate of overnight deposits from households and non-financial corporations, respectively, where we condition on our measures of deposit reliance (panel a) and

[23] See figures C3-C7 in the appendix for a robustness exercise where we use as instrument the monetary policy shocks of Altavilla et al. (2019) or simple OLS regression.

of deposit market power (panel b). For both state-variables and both types of depositors, when we fix the value of the state-variable at the third quartile of the distribution (denoted as p75 in the figure) the effect is significantly smaller than when conditioning on the value corresponding to the first quartile (p25 in the figure). Hence, according to our estimates banks that rely more on deposits in their funding or with a higher deposit market power have a lower pass-through of policy rate changes to overnight deposit remuneration. Since, as outlined in Section 2, both measures have increased over the time series, especially after 2015, (and in the cross-section), this evidence suggests a possible explanation behind the documented missing pass-through in the 2022-23 monetary tightening at aggregated level.

FIGURE 7. STATE-DEPENDENT PASS-THROUGH TO OVERNIGHT DEPOSIT RATES FROM NON-FINANCIAL CORPORATIONS

a. Conditioning on deposit reliance b. Conditioning on deposit market power



Notes: This figure plots our estimates of equation (2) for the impulse response of a monetary policy shock for ON deposit rates from non-financial firms conditioning on deposit reliance (panel a) and deposit market power (panel b). The two lines p25) and p75) denote, respectively, the first and third quartile of the distribution of our conditioning variable. Our sample spans from 2008M07 to 2023M12 at monthly frequency. The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

Finally, to assess the relative importance of the two state variables, we estimate equation (2) *jointly* conditioning on both deposit reliance and deposit market power. To ease the interpretation, before the estimation we standardize the state variables so that the coefficients are comparable in scale.[24] Results are qualitatively similar in both cases.

TABLE 1. JOINT ESTIMATION OF THE CONDITIONAL PASS-THROUGH

Horizon (months)	0	1	2	10	11	12
			Panel A: Households			
i	0.126***	0.144***	0.155***	0.160***	0.160***	0.162***
	(0.026)	(0.023)	(0.020)	(0.019)	(0.019)	(0.020)
$i \times Dep/Tot.\ Liab$	−0.091***	−0.095***	−0.093***	−0.045**	−0.039*	−0.033
	(0.034)	(0.029)	(0.026)	(0.022)	(0.023)	(0.023)
$i \times Mkt.\ Pwr$	−0.013	−0.022	−0.030**	−0.033**	−0.036***	−0.046***
	(0.016)	(0.015)	(0.014)	(0.013)	(0.012)	(0.013)
			Panel B: Non-financial firms			
i	0.153***	0.205***	0.242***	0.270***	0.270***	0.273***
	(0.027)	(0.023)	(0.021)	(0.024)	(0.024)	(0.024)
$i \times Dep/Tot.\ Liab$	−0.080**	−0.083***	−0.087***	−0.034	−0.027	−0.015
	(0.034)	(0.030)	(0.028)	(0.029)	(0.029)	(0.029)
$i \times Mkt.\ Pwr$	−0.056***	−0.085***	−0.082***	−0.077***	−0.078***	−0.087***
	(0.020)	(0.019)	(0.017)	(0.017)	(0.016)	(0.017)

Notes: This table report our estimates of equation (2) for the impulse response of a monetary policy shock at several horizons (columns) for deposit rates for households (panel a) and non-financial firms (panel b) where we *jointly* condition on both deposit reliance (i× $Dep/Tot.\ Liab$) and market power (i× $Mkt.\ Pwr$). The average unconditional pass-through is given by the coefficient i while the overall pass-through by the sum of three terms where the conditioning variables are set at the appropriate values (e.g., sample average in 2022-2023). Standard errors are in parenthesis and are robust to heteroskedasticity and autocorrelation.

Table 1 reports our findings for several horizons h for overnight deposit rates from households (panel a) and non-financial corporations (panel b). First, we note that banks with a higher degree of deposit market power and with higher deposit reliance are both associated with a lower pass-through of monetary policy, consistent with the evidence in Figure 6 and Figure 7 where the role of the state-variables is assessed separately. For households, in the very short-term the interaction coefficient associated with banks' deposit reliance is statistically significant and more negative than that referring to deposit market power. At longer horizons, the opposite is true with only deposit market power having an

[24] In the Appendix we also orthogonalize the state variables so that the exercise is closer in spirit to a "true" forecast variance decomposition (although here we are not dealing with proper shocks).

interaction coefficient that remains significantly different from zero, therefore maintaining a role in affecting the heterogeneity in monetary policy pass-through. The results for non-financial corporations are qualitatively similar, but with less difference in the impact of the two state variables in the very short term, as the two interaction coefficients are both statistically significant and have a similar magnitude.

We interpret this evidence as suggestive of the fact that higher deposit market power has a more persistent role in lowering the monetary policy pass-through as compared to deposits reliance, which appears to be relevant mainly in the short-term.

4.3 Implications for lending rates

In this section we assess whether deposit market power and deposit reliance have a dampening effect also on the pass-through of monetary policy to lending rates. A positive result would suggest that the influence of these state variables extends beyond bank funding costs, affecting the broader transmission of monetary policy and shaping financing conditions for households and non-financial corporations.

To answer this question, we exploit once again the state-dependent local projection framework of equation (2) where we separately condition on our measure of deposit reliance and deposit market power.[25] Since the model is linear in the coefficients, this procedure is equivalent to condition on the pass-through to overnight deposit rates. The main difference with respect to the specification for overnight deposits is that we use the 1-year IRS as the reference rate for new loans to non-financial corporations, which better reflects the average maturity of these loans. Finally, because our focus is mainly on deposit liabilities, we remark that

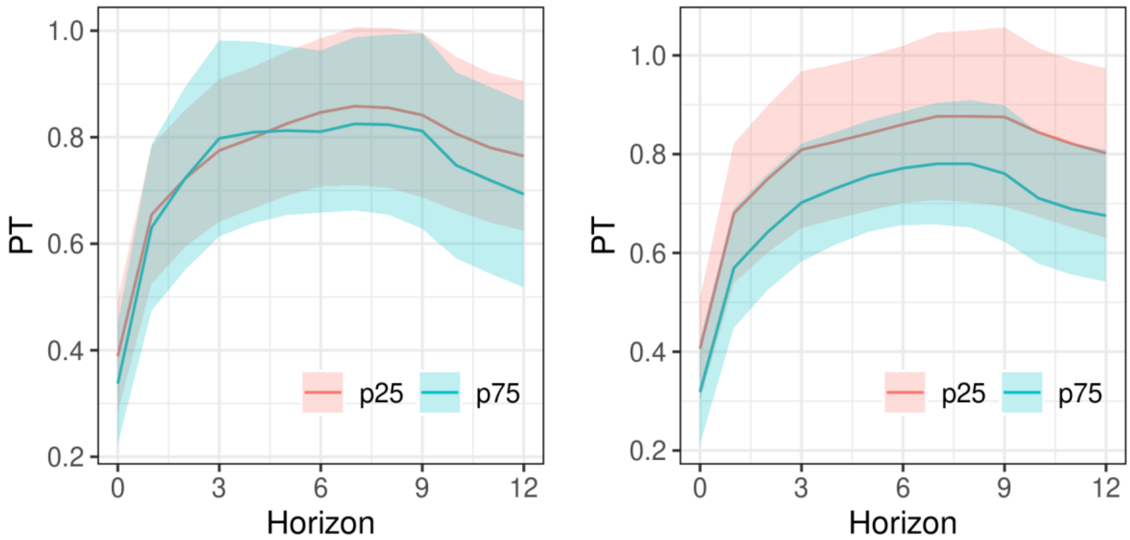
[25] See the Appendix for the estimates of the unconditional pass-through of monetary policy to lending rates.

apart from the standard controls we do not include any explanatory variable associated with the loan portfolio in the regression.

FIGURE 8. STATE-DEPENDENT PASS-THROUGH TO NFCS LENDING RATES

a. Conditioning on deposit reliance

b. Conditioning on deposit market power



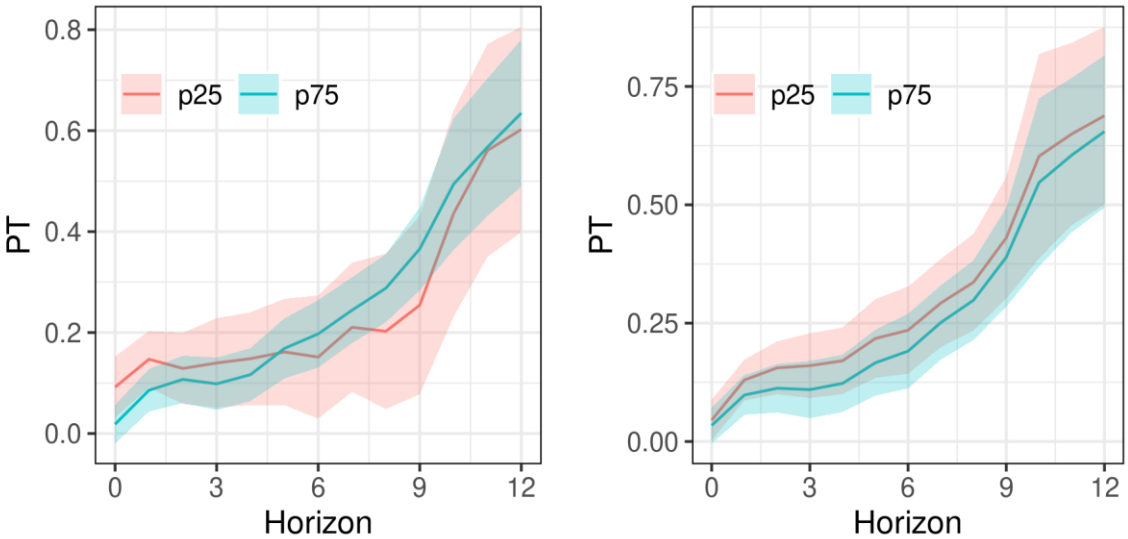
Notes: This figure plots our estimates of equation (2) for the impulse response of a monetary policy shock for NFC lending rates conditioning on deposit reliance (panel a) and deposit market power (panel b). We use as market reference rate $i_{t+h} - i_{t-1}$the 1-year IRS and as instrument the high-frequency monetary policy shocks from Jarociński and Karadi (2020). The two lines p25) and p75) denote, respectively, the first and third quartile of the distribution of our conditioning variable. Our sample spans from 2008M07 to 2023M12 at monthly frequency. The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

Figure 8 presents our results for deposit reliance (panel a) and deposit market power (panel b). Consistently with the evidence on overnight deposits (especially from non-financial corporations), an increase in deposit market power reduces the overall pass-through to lending rates, albeit to a lesser extent. On the contrary, deposit reliance does not have a significant impact in shaping the pass-through to lending rates.

We conduct a similar exercise with households mortgage rates. As for loans to non-financial corporations, we slightly adjust our benchmark specification in equation (2), using the 10-year IRS as market reference rate and the corresponding high-frequency surpries to the 10-year OIS from Altavilla et. al (2019) as instrument.[26] This modification better captures the average long-term duration of mortgages in the euro area. Consistently with the evidence for non-financial corporations, we find no effect of deposit reliance on the pass-through to mortgage rates (figure 9, panel a) and a significant effect of deposit market power (figure 9, panel b).[27]

FIGURE 9. STATE-DEPENDENT PASS-THROUGH TO HHS MORTGAGE RATES

a. Conditioning on deposit reliance   b. Conditioning on deposit market power



Notes: This figure plots our estimates of equation (2) for the impulse response of a monetary policy shock for HH mortgage rates conditioning on deposit reliance (panel a) and deposit market power (panel b). We use as reference rate $i_{t+h} - i_{t-1}$the 10-year IRS and as instrument the corresponding high-frequency shock to the 10-year OIS from Altavilla et al. (2019). The two lines p25) and p75) denote, respectively, the first and third quartile of the distribution of our conditioning variable. Our sample spans from 2011M07 to 2023M12 at monthly frequency. The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

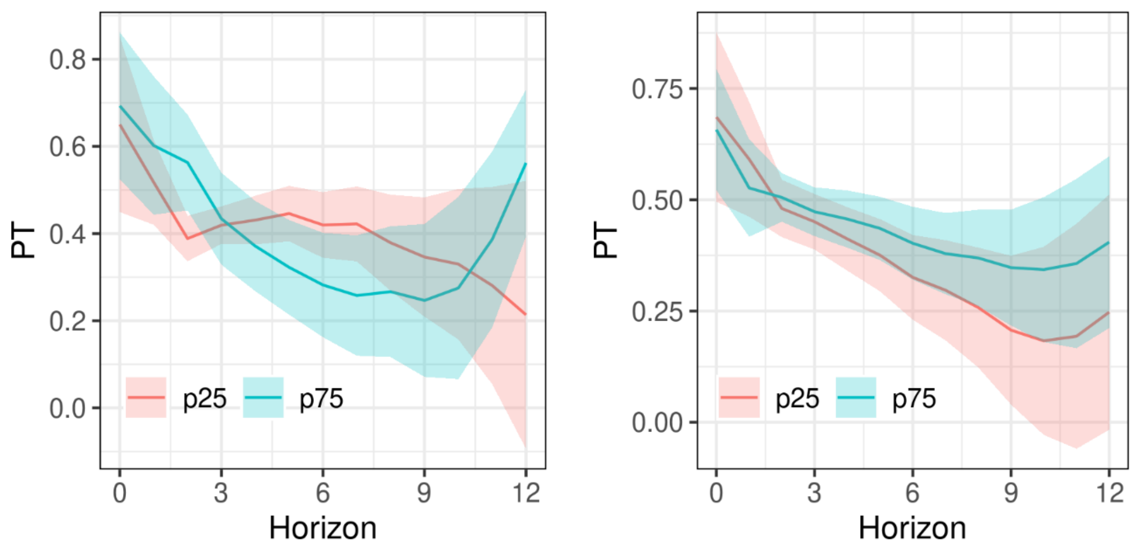
Finally, to assess the net impact of deposit market power on banks interest margins, we estimate the pass-through to banks' loan–deposit spread, defined as the difference between the (volume-weighted) average interest rate charged on loans to households and non-financial corporations and the (volume-weighted) average interest rate paid on overnight deposits from households and non-financial corporations, using our state-dependent local projection framework in equation (2).

[26] Due to data availability of the 10-year OIS surprise, our sample starts in 2011M07.
[27] The pass-through stabilizes at approximately 0.5–0.7 over a 15-month horizon (not shown).

Figure 10 presents our results. According to our estimates, a 100 basis point surprise in the reference rate causes spreads to widen by approximately 50–70 basis points on impact, followed by a gradual decrease over time. This finding is consistent with our previous evidence that deposit rates adjust more slowly compared to loans. Notably, we also observe that deposit market power contributes to widening the spreads, as its dampening effect on deposit rates more than offsets its impact on lending rates. In contrast, the effect of deposit reliance (panel a) is mostly insignificant.

FIGURE 10. STATE-DEPENDENT PASS-THROUGH TO LOAN–DEPOSIT SPREADS

a. Conditioning on deposit reliance b. Conditioning on deposit market power



Notes: This figure plots our estimates of equation (2) for the impulse response of a monetary policy shock for the loan - deposit spread conditioning on deposit reliance (panel a) and deposit market power (panel b). We use as reference rate $i_{t+h} - i_{t-1}$the 3-month Euribor and as instrument the high-frequency monetary policy shocks from Jarociński and Karadi (2020). The two lines p25) and p75) denote, respectively, the first and third quartile of the distribution of our conditioning variable. Our sample spans from 2011M07 to 2023M12 at monthly frequency. The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

5. CONCLUDING REMARKS

In this paper we show that during the 2022-23 ECB's tightening cycle the pass-through from monetary policy rates to the remuneration of overnight deposits was extremely muted compared to historical regularities. Using granular bank-level information, we also find that the increase in banks' deposit reliance and deposit market power, largely associated with the very accommodative monetary policy stance implemented before the emergence of inflationary pressures, contributed to explaining this missing pass-through in the subsequent tightening cycle. While deposit reliance dampens the sensitivity of overnight deposit rates mainly in the short term, the effect of deposit market power is more persistent. The dampening effect of deposit market power furthermore extends beyond bank funding costs and affects the broader transmission of monetary policy to financing conditions for households and non-financial corporations, but with a widening in the loan–deposit spread.

Our findings carry relevant policy implications. First, they suggest that maintaining policy rates for a prolonged period at low or even negative levels and implementing large asset purchase programmes, both of which contribute to increasing the reliance of banks on overnight deposits, *per se* do not disrupt the regular transmission mechanism of monetary policy to bank funding costs and to lending rates. Second, the increase in the deposit market power has a dampening effect on the pass-through of monetary policy that can be more relevant and persistent. Policy actions aimed at promoting competition across banks may be warranted to continue ensuring a smooth transmission of monetary policy to bank funding costs and broader financing conditions for the private sector.

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APPENDIX

A BAYESIAN VAR FRAMEWORK

A.1 Model

To evaluate whether the transmission of policy rates to overnight deposit rates aligns with historical patterns, we employ a Bayesian Vector Auto Regression (BVAR) framework. Specifically, we set-up the following small-scale BVAR model:[28]

$$\boldsymbol{Y}_t = \boldsymbol{c} + \boldsymbol{B}(L)\boldsymbol{Y}_{t-1} + \boldsymbol{u}_t \tag{A.1}$$

where $\boldsymbol{Y}$ is a vector of endogenous variables, $\boldsymbol{c}$ is a vector of constant terms, and $\boldsymbol{u}$ is a vector of residuals $\boldsymbol{u}_t \sim nid(\boldsymbol{0}, \boldsymbol{\Sigma})$. $\boldsymbol{B}(L)$ is a matrix polynomial in the lag operator L, while t denotes the (monthly) time frequency and $\boldsymbol{\Sigma}$ is a variance/covariance matrix.

Our baseline BVAR includes three endogenous variables: short- and long-term market rates (the 3-month EURIBOR and the 10-year IRS, respectively), and deposit rates from NFCs and HHs, one at a time. In the BVAR in equation (A.1), the estimation is conducted in levels. We set the number of lags to 12, which is the minimum to yield uncorrelated residuals.

We estimate the model using a Normal-inverted Wishart prior and posterior. The basic prior on the VAR coefficients has a Minnesota structure. The mean prior is set to one for each variable's own first lag and zero elsewhere, with a diffuse prior for the covariance matrix of the error terms. The overall tightness of the prior is set to 0.4, a slightly higher value compared to the standard used in the literature, as it

[28] This BVAR is a simplified version of the larger model developed by Auer and Conti (2024) for studying the dynamics of lending volumes and used also in Conti et al. (2024) for studying the effects of the ECB 2022-23 monetary tightening on real GDP and consumer prices.

is found optimal according to a grid search (similarly to Aastveit et al., 2017). This value improves the performance of conditional forecasts – that is, their fit with the realized values – because it also helps to deal with Covid-19 observations, making the prior more diffuse and giving more relevance to sample estimation in the posterior.[29] The prior for the constant is normal with a zero mean and a standard deviation of 1000.

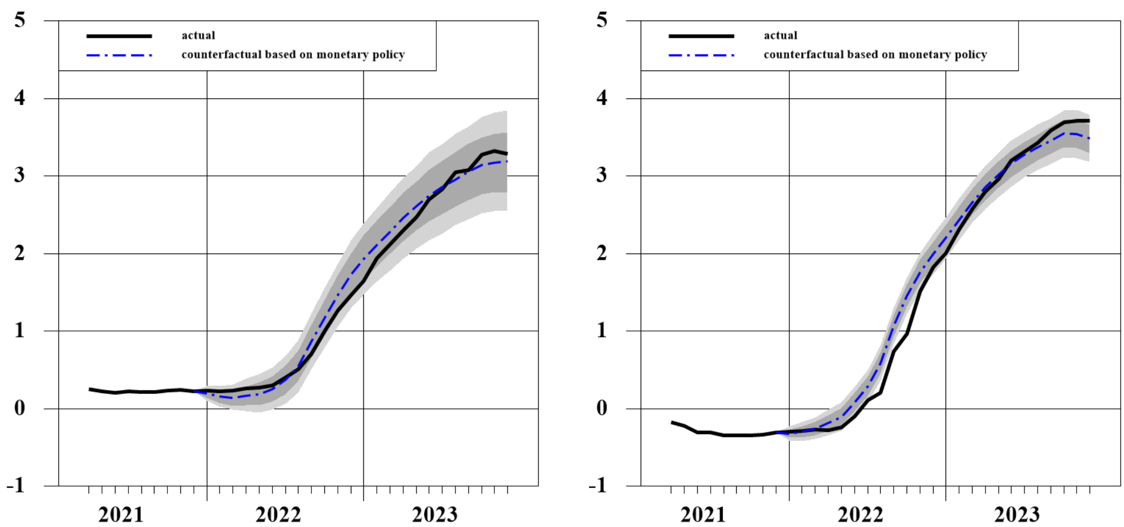
Finally, we also supplement the usual Minnesota prior with the "sum of coefficients" and "dummy initial observation" priors proposed in Doan et al. (1984) and Sims (1993), respectively. In all conditional forecasting exercises, we set the hyperparameters governing the tightness on the sum of coefficients prior, and the tightness on the cointegration prior at uninformative values.

A.2 Transmission to term deposit rates

FIGURE A1. PASS-THROUGH FROM POLICY RATES TO TERM DEPOSIT RATES

a. Households

b. Non-financial corporations



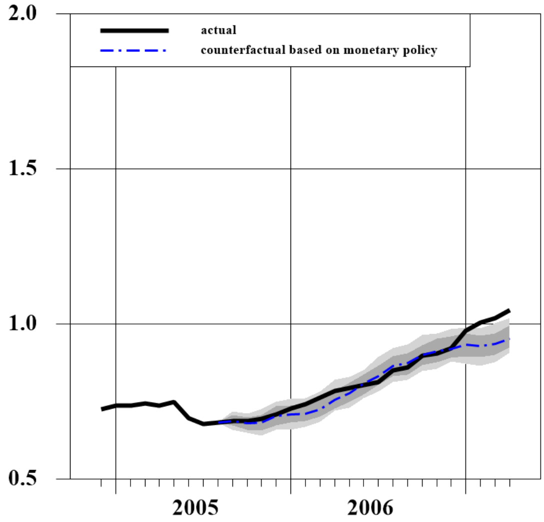
Notes: The dark (light) grey shaded area is the 68% (90%) credible interval obtained from the BVAR posterior distribution. Estimation sample is 2000:M1-2021:M12.

[29] The results are robust to changes in prior settings.

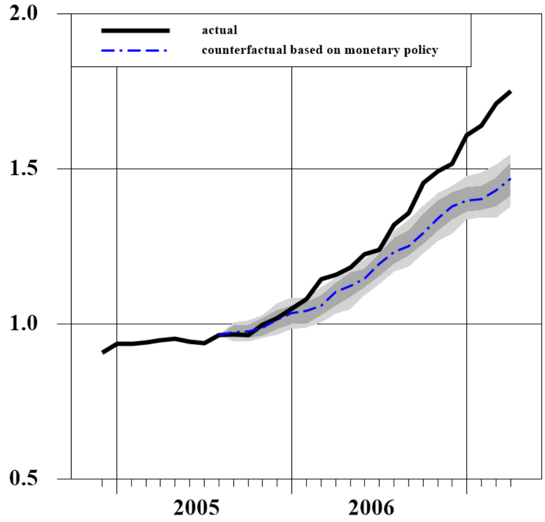
A.3 Model validation over the previous tightening cycle

FIGURE A2. PASS-THROUGH FROM POLICY TO OVERNIGHT DEPOSIT RATES: 2005-08

a. Households



b. Non-financial corporations



Notes: The dark (light) grey shaded area is the 68% (90%) credible interval obtained from the BVAR posterior distribution. Estimation sample is 2000:M1-2005:M7.

B ESTIMATION OF DEPOSIT MARKET POWER

This section provides a brief overview of the construction of our measure of deposit market power. For further details on the estimation procedure refer to Albertazzi et al. (2022) and the references therein. The primary difference between our framework and that in Albertazzi et al. (2022)—which uses the same iBSI and iMIR data but restricts the sample to banks with quoted CDS spreads—is that we explicitly model the demand for term deposits alongside that for overnight deposits, whereas they focus on the distinction between insured and uninsured *total* deposits.

We model the demand for deposits by specifying the indirect utility U_{ijmt} that agent i derives from the choice of bank j:

$$U_{ijmt} = \alpha P_{jmt} + \delta_j + \lambda_{mt} + \xi_{jmt} + \epsilon_{ijmt} \tag{B.1}$$

where P_{ijmt} is the interest rate on deposit, δ_j and λ_{mt} are bank and country-month fixed effects, and ξ_{jmt} are bank-country-month unobserved characteristics (by the econometrician) that may be correlated with deposit interest rates.

We define a market as a country-month couple, and in each market banks compete on prices and offer two differentiated savings products: overnight and term deposits (or deposits with an agreed maturity). This assumption is a parsimonious way of modelling the imperfect substitutability between the two products that may be especially relevant during a period of rates hikes/cuts. Due to data limitation, we model the outside option as the set of small "fringe" banks that do not report directly in iMIR/iBSI but that are part of the national aggregate figures. Finally, to allow for different demand elasticities (and different market power), the choice sets for households and non-financial corporations are distinct, so that e.g., a household cannot select a remuneration offered to a firm.

Assuming, as is standard in the literature, that agents make mutually exclusive choices and that the random shocks ϵ_{ijmt} are i.i.d. with type I extreme value distribution, we have the standard logistic expression for deposit market shares:

$$S_{jmt} = \frac{\exp\left(\alpha P_{jmt} + \delta_j + \lambda_{mt} + \xi_{jmt}\right)}{1 + \sum_k \exp(\alpha P_{kmt} + \delta_k + \lambda_{mt} + \xi_{kmt})} \tag{B.2}$$

that we estimate in log-odds as in Berry (1994), i.e.

$$\log\left(S_{jmt}\right) - \log(S_{0mt}) = \alpha P_{jmt} + \delta_j + \lambda_{mt} + \xi_{jmt} \tag{B.3}$$

where the unobserved characteristics ξ_{jmt} act as a residual that may be correlated with the interest rate P_{jmt}. In order to properly identify α, we construct an instrument in the spirit of Villas-Boas (2007) interacting bank-product dummies with the 3-month Euribor that we use as a cost shifter.

Finally, assuming a simple risk-neutral profit maximiser bank with per-period (expected) profit:

$$\begin{gathered} \max_{r^d_{jmt}} \Pi_{jmt} = A_{jmt}\overline{r_{jmt}} - D_{jmt}\left(P^d_{jmt}\right)P^d_{jmt} - N_{jmt}P^f_t - \phi_{jmt}D_{jmt}\left(P^d_{jmt}\right) \\ s.t.\ A_{jmt} = D_{jmt} + N_{jmt} + E_{jmt} \end{gathered} \tag{B.4}$$

with average exogenous return $\overline{r_{jmt}}$ on its assets A_{jmt}, pre-determined equity E_{jmt}, (net) borrowing N_{jmt} at the benchmark rate of P^f_t, and unobserved marginal cost ϕ_{jmt} of taking new deposits, the FOC reads:

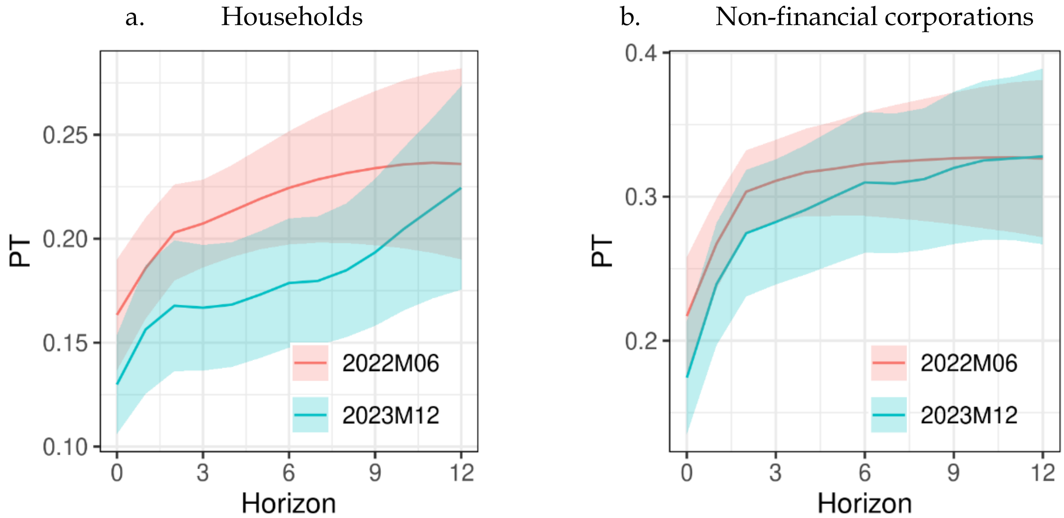
$$
\begin{aligned}
mktpwr_{jmt} &= P_t^f - \phi_{jmt} - P_{jmt}^d = -\left(\frac{\partial D_{jmt}}{\partial P_{jmt}} \frac{1}{D_{jmt}}\right)^{-1} \\
&= -\left(\frac{1}{\alpha(1 - S_{jmt})}\right)
\end{aligned}
\tag{B.5}
$$

The (standardized) estimates of banks' $mktpwr$ are plotted in Figure 4

C Robustness and further results

FIGURE C1. UNCONDITIONAL PASS-THROUGH TO OVERNIGHT DEPOSIT RATES:

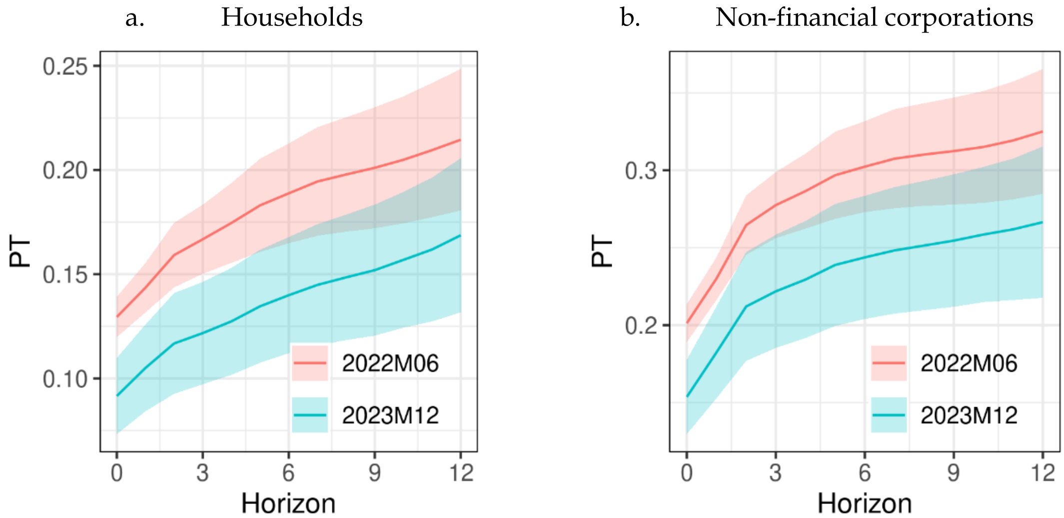
DIFFERENT MONETARY POLICY SHOCKS



Notes: This figure plots the impulse response of a monetary policy shock for ON deposit rates from households (panel a) and non-financial firms (panel b) from the estimation of equation (1) on two samples: from 2008M07 to 2022M06 (pre-tightening, denoted as 2022M06) and from 2008M07 to 2023M12 (full sample, denoted as 2023M12). We use as instrument the high-frequency monetary policy shocks from Altavilla et al. (2019). The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

FIGURE C2. UNCONDITIONAL PASS-THROUGH TO OVERNIGHT DEPOSIT RATES:

OLS REGRESSION

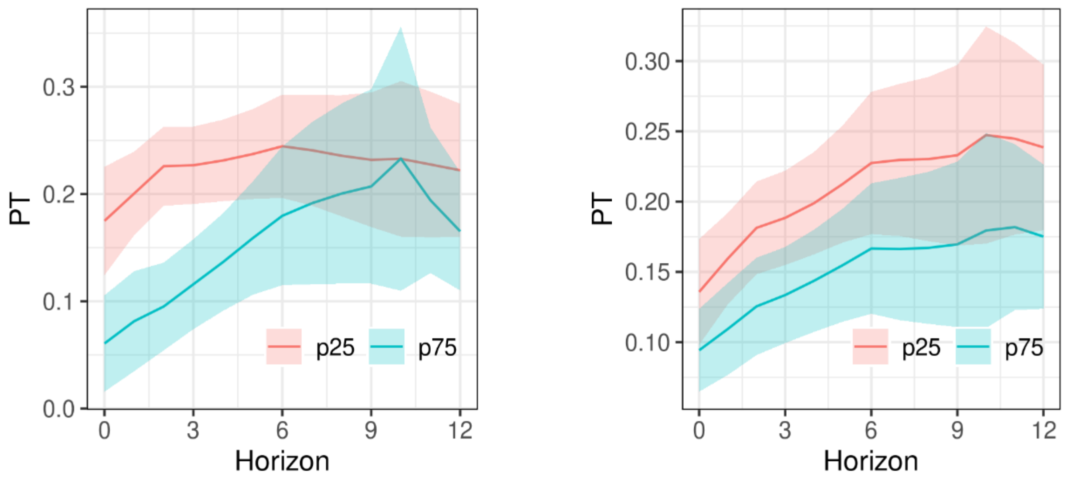


Notes: This figure plots the impulse response of a monetary policy shock for ON deposit rates from households (panel a) and non-financial firms (panel b) from the estimation of equation (1), treating the shock to the Euribor reference rate as *exogenous*, on two samples: from 2008M07 to 2022M06 (pre-tightening, denoted as 2022M06) and from 2008M07 to 2023M12 (full sample, denoted as 2023M12). The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

FIGURE C3. STATE-DEPENDENT PASS-THROUGH TO OVN. DEPOSIT RATES FROM HHS: DIFFERENT MONETARY POLICY SHOCKS

a. Conditioning on deposit reliance

b. Conditioning on deposit market power

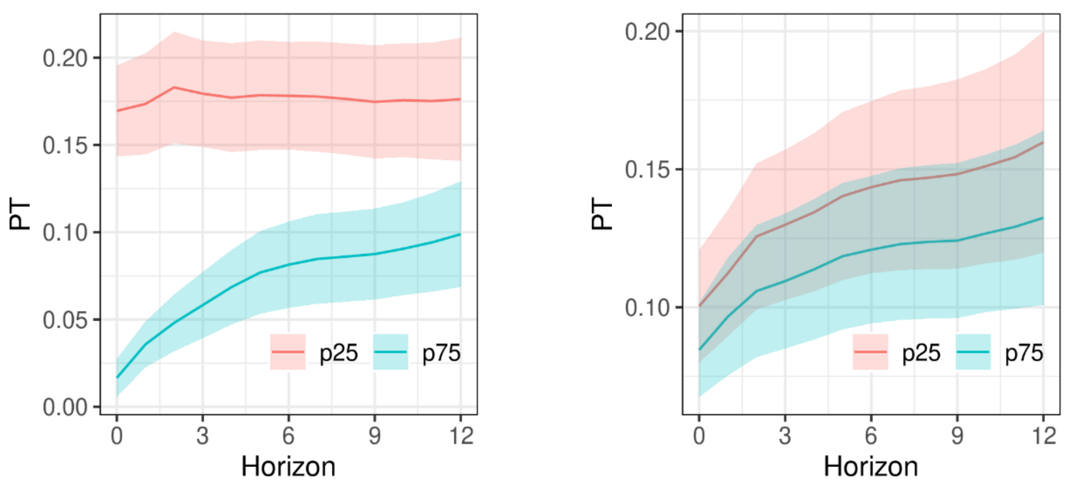


Notes: This figure plots our estimates of equation (2) for the impulse response of a monetary policy shock for ON deposit rates from households conditioning on deposit reliance (panel a) and deposit market power (panel b). The two lines p25) and p75) denote, respectively, the first and third quartile of the distribution of our conditioning variable. Our sample spans from 2008M07 to 2023M12 at monthly frequency. We use as instrument the high-frequency monetary policy shocks from Altavilla et al. (2019). The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

FIGURE C4. STATE-DEPENDENT PASS-THROUGH TO OVN. DEPOSIT RATES FROM HHS: OLS REGRESSION

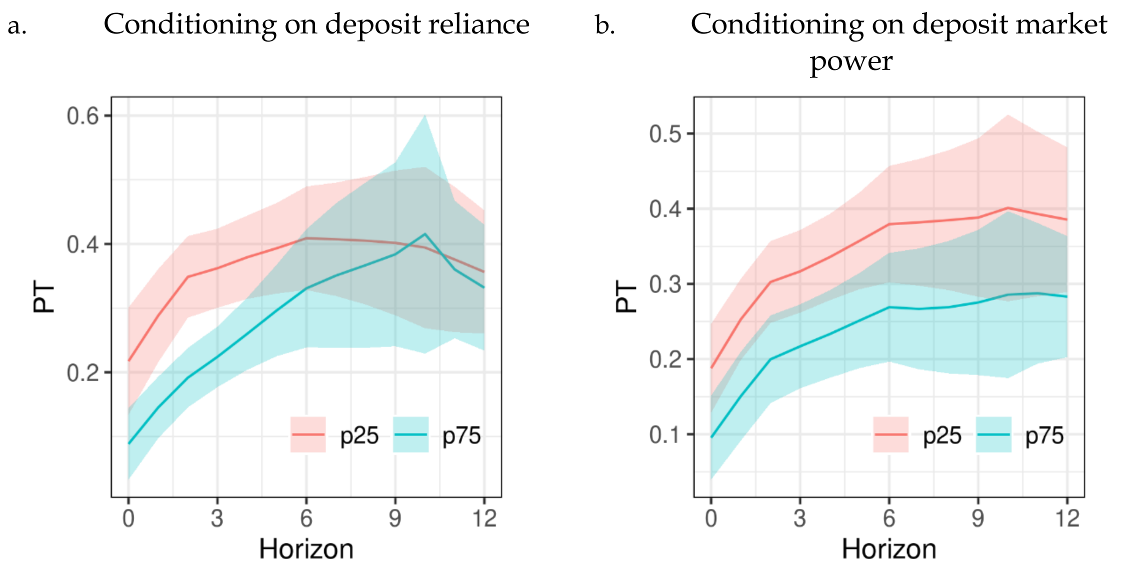
a. Conditioning on deposit reliance

b. Conditioning on deposit market power



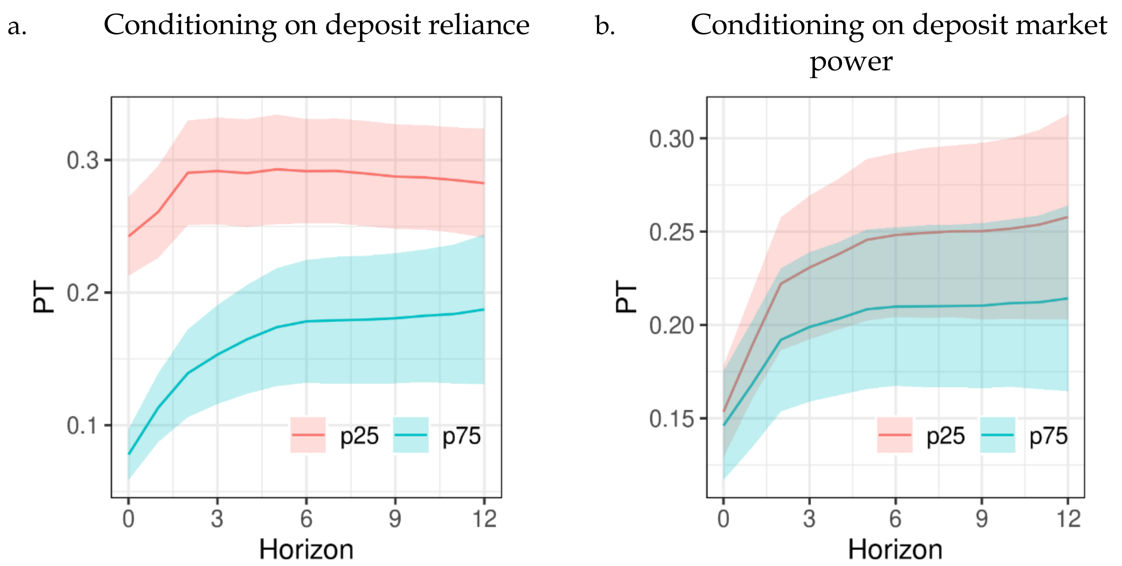
Notes: This figure plots our estimates of equation (2) for the impulse response of a monetary policy shock for ON deposit rates from households conditioning on deposit reliance (panel a) and deposit market power (panel b) treating the shock to the Euribor reference rate as *exogenous*. The two lines p25) and p75) denote, respectively, the first and third quartile of the distribution of our conditioning variable. Our sample spans from 2008M07 to 2023M12 at monthly frequency. The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

FIGURE C5. STATE-DEPENDENT PASS-THROUGH TO OVN. DEPOSIT RATES FROM NFCS: DIFFERENT MONETARY POLICY SHOCKS



Notes: This figure plots our estimates of equation (2) for the impulse response of a monetary policy shock for ON deposit rates from non-financial firms conditioning on deposit reliance (panel a) and deposit market power (panel b). The two lines p25) and p75) denote, respectively, the first and third quartile of the distribution of our conditioning variable. Our sample spans from 2008M07 to 2023M12 at monthly frequency. We use as instrument the high-frequency monetary policy shocks from Altavilla et al. (2019). The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

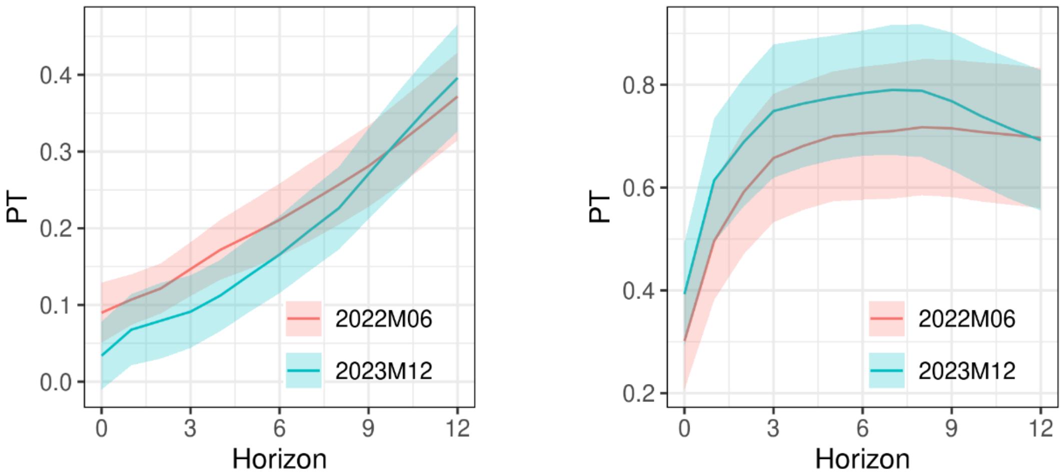
FIGURE C6. STATE-DEPENDENT PASS-THROUGH TO OVN. DEPOSIT RATES FROM NFCS: OLS REGRESSION



Notes: This figure plots our estimates of equation (2) for the impulse response of a monetary policy shock for ON deposit rates from non-financial firms conditioning on deposit reliance (panel a) and deposit market power (panel b) treating the shock to the Euribor reference rate as *exogenous*. The two lines p25) and p75) denote, respectively, the first and third quartile of the distribution of our conditioning variable. Our sample spans from 2008M07 to 2023M12 at monthly frequency. The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

FIGURE C7. UNCONDITIONAL PASS-THROUGH TO LENDING RATES

a. Households | b. Non-financial corporations



Notes: This figure plots our estimates of equation (1) for the impulse response of a monetary policy shock for lending rates to households (panel a) and non-financial firms (panel b) on two samples: from 2008M07 to 2022M06 (pre-tightening, denoted as 2022M06) and from 2008M07 to 2023M12 (full sample, denoted as 2023M12). The shaded area is the 68% confidence interval with Driscoll-Kray standard errors.

TABLE C1. JOINT ESTIMATION OF THE CONDITIONAL PASS-THROUGH:

ORTHOGONALIZED STATE VARIABLES

Horizon (months)	0	1	2	10	11	12
			Panel A: Households			
i	0.116^{***}	0.134^{***}	0.145^{***}	0.155^{***}	0.156^{***}	0.159^{***}
	(0.024)	(0.030)	(0.031)	(0.037)	(0.038)	(0.043)
$i \times Dep/Tot.\ Liab$	-0.087^{***}	-0.092^{***}	-0.091^{***}	-0.046^{**}	-0.041^{*}	-0.036
	(0.026)	(0.020)	(0.015)	(0.021)	(0.023)	(0.025)
$i \times Mkt.\ Pwr$	-0.013	-0.021	-0.029^{**}	-0.032^{*}	-0.036^{**}	-0.045^{**}
	(0.017)	(0.014)	(0.012)	(0.018)	(0.017)	(0.018)
			Panel B: Non-financial firms			
i	0.144^{***}	0.196^{***}	0.233^{***}	0.266^{***}	0.267^{***}	0.272^{***}
	(0.041)	(0.048)	(0.046)	(0.062)	(0.063)	(0.069)
$i \times Dep/Tot.\ Liab$	-0.081^{***}	-0.087^{***}	-0.089^{***}	-0.039	-0.033	-0.022
	(0.030)	(0.026)	(0.020)	(0.024)	(0.027)	(0.034)
$i \times Mkt.\ Pwr$	-0.055^{***}	-0.083^{***}	-0.081^{***}	-0.076^{***}	-0.077^{***}	-0.085^{***}
	(0.021)	(0.023)	(0.018)	(0.027)	(0.026)	(0.028)

Notes: This table report our estimates of equation (2) for the impulse response of a monetary policy shock at several horizons (columns) for deposit rates for households (panel a) and non-financial firms (panel b) where we *jointly* condition on *orthogonalized* both deposit reliance (i× $Dep/Tot.\ Liab$) and market power (i× $Mkt.\ Pwr$). The average unconditional pass-through is given by the coefficient i while the overall pass-through by the sum of three terms where the conditioning variables are set at the appropriate values (e.g., sample average in 2022-2023). Standard errors are in parenthesis and are robust to heteroskedasticity and autocorrelation.